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ABSTRACT

The guide, one in a series of committee reports relating to school band performance, organization, and equipment needs, discusses acoustical problems inherent to the clarinet. The report is presented in five sections. Section I summarizes findings of an American School Band Directors' Association (ASBDA) clarinet testing committee. A major finding was that all clarinets follow a consistent intonation pattern. Section II summarizes ASBDA committee findings regarding clarinet mouthpieces. On the basis of tests of 78 mouthpieces, the committee recommended that manufacturers agree to an identification system for pitch levels. Section III presents a list of tuning practices followed by clarinetists. Section IV examines mouthpiece pitch characteristics, including tone quality, ease of blowing, articulation, and staccato control. Section V presents conclusions. These include that music teachers should recommend mouthpieces to students and that mouthpieces which play flat as well as sharp are necessary for good intonation in a band section. The appendix presents graphs illustrating differences among clarinet mouthpieces; a tuning and warm-up standard form; and a list of clarinet mouthpieces by brand name, number, pitch characteristic, and average pitch level. (Author/DB)

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Twelve Years of Acoustical Research.

AMERICAN SCHOOL BAND DIRECTORS' ASSOCIATION

James M. Tibbs, President

RESEARCH COMMITTEE REPORTS

for the

17th ANNUAL CONVENTION

HOT SPRINGS, ARKANSAS

December 3 - 7, 1969

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General Chairman of Research

Alvin E. Bohms - Fraser, Michigan

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AMERICAN SCHOOL BAND DIRECTORS ASSOCIATION

ACOUSTICAL RESEARCH

WARREN FELTS - CHAIRMAN

COMMITTEE MEMBERS

Elwood Nichols, Indiana

Ed Kehn, Colorado

Pat Patterson, Texas

Leroy Wolter, Wisconsin

Cleon Etzkorn, Illinois

AMERICAN SCHOOL BAND DIRECTORS ASSOCIATION

TWELVE YEARS OF ACOUSTICAL RESEARCH

History and Orientation.

At the A.S.B.D.A. National Convention in Boulder, Colorado, mid-summer 1957, President Pat Arsers of Texas, appointed a committee to delve into the acoustical problems inherent to musical instruments. It was felt that problems in tone quality, tone production, intonation, etc., might be pin-pointed by studying the acoustics of instruments and testing available instruments. There was hope that the results would be grounds for making recommendations to directors, performers, and manufacturers, for the improvement of musical performance.

Pat Arsers appointed Ed Kehn, Colorado; Emil Puffenberger, Ohio; Warren Felts, Illinois; and Pat Patterson, Texas as committee members and Pat Arsers, Texas as Chairman. Other members appointed by later Presidents were: Donald Gjerdrum, Minnesota; Arlie Richardson, California; Elwood Nichols, Indiana; Glenn Walker, Ohio; Leroy Wolter, Wisconsin; and Cleon Etzkorn, Illinois. Ed Kehn, Elwood Nichols, and Warren Felts, have also served as chairmen of the committee.

The committee contacted instrument manufacturers to seek help with the research. C. G. Conn Corporation of Elkhart, Indiana offered its extensive research laboratory, facilities, equipment, and engineering personnel to our A.S.B.D.A. committee. The committee gladly accepted this offer with the understanding that any findings would be made available to all manufacturers and interested individuals.

Many long but intensely interesting days were spent at the Conn factory with Dr. Earl Kent, Dr. Jody Hall, and Norman Todenhoft. These distinguished gentlemen "schooled" the men in the science of acoustics, sound production, the human ear, sound wave intensity, pitch, quality, etc. Much time was also spent observing the manufacture of musical instruments and discussing the materials and tolerances, strengths and weaknesses, and the problems and inconsistencies of manufacture.

The committee gained much knowledge in acoustical problems while testing many variations of cornet and trumpet bells and hearing the resulting tone qualities. The direction of the sound, the human element of the

performer, and the reflective qualities of the performing area were all considered significant in the quality of the tone. The acoustical engineers and designers tried to develop a nomenclature to which to turn. They wanted to know what is meant when a tone is said to be "bright", "stuffy", "round", "dark", "liquid", "thin", "throaty", etc. Many hours were spent in listening to upper brass and clarinet tones and classifying them. A study of the picture of the wave length showed that tones of the same quality produced the same picture. For instance, stuffy tones looked the same, bright tones looked the same, etc.

After these experiments, discussions, and experiences, the committee chose to test clarinets. It was desired to discover if altitude, temperature, humidity, reed strength, and other elements affected clarinet response and intonation.

The "ASBDA Research Committee, Tuning and Warm Up Standard, Revised 1961" was developed by committee members as a basis of clarinet testing. (See page 11).

The validations for some of the findings in this report are not reported in this paper. However, the validation data are on file in the Archives of the Association of the Acoustics Committee.

Summary of the Findings.

Many months of extensive testing in various parts of the country, at different altitudes, different humidity levels, and different temperatures, convinced the committee of the following:

1. All clarinets regardless of price or make follow a consistent intonation graph.

2. Altitude has no effect on pitch and intonation. Some difference in playing response and a necessity for change of reed strength is noted at higher altitude.

3. Humidity has no effect on response, tone, or pitch. The bore is immediately saturated by the breath under any conditions.

4. Heat does have a great deal to do with pitch level. Instruments play much sharper with extreme heat (Hot-Wire Experiment). Heat from the breath has more effect upon the short tube notes than the long tube notes.

5. If clarinets are pulled at the joints, rings must be used to

insure good playing response. In any case, the clarinet must not be pulled more than 1/16" at the barrel, nor 1/32" between the branches; otherwise, the clarinet intonation pattern is thrown off.

The committee then chose to focus attention on the clarinet mouthpiece. Ed Kehn wrote to clarinet mouthpiece manufacturers asking for samples of their best selling mouthpieces. Seventy eight mouthpieces were eventually tested by many clarinetists at all performance levels on many makes of clarinets, and under many conditions and reed strengths. It was found that:

1. reed strength affected the response, but not the intonation,

2. mouthpieces had no consistent identification throughout the industry and in most companies as to performance expected relative to pitch and response,

3. there is a great difference in the physical length of clarinet mouthpieces,

4. there was a wide variance in the intonation level of the mouthpieces tested. They varied from the sharpest at a + 20.1 cents to the flattest at a - 11.9 cents,

5. by testing several so-called identical mouthpieces, it was found that they were quite inconsistent though "generally" sharp, "generally" medium, or "generally" flat,

6. the pitch of the instrument was not affected to any great degree by the materials used. However, because of the pliability of some materials and inconsistencies in manufacturing, resultant warping often causes change in the playing characteristics.

It is felt that it is necessary for manufacturers to agree to an identification system for all mouthpieces. They should also publish the playing characteristics of each mouthpiece, as to pitch level, playing response, etc.

Research needs to be made with materials and methods of manufacture to perfect quality control so that all mouthpieces manufactured with identical markings will indeed be identical in playing characteristics.

Hot Wire Experiment.

To demonstrate the effect of changing temperature upon the clarinet,

C. G. Conn built a clarinet with a heating wire in it, plus separate thermistors at the barrel, midpoint, and the bell, Varying temperatures were measured within the clarinet at those points. The effect that a change of temperature at these points had upon the pitch was measured.

The temperature of the air in the instrument becomes progressively lower from the mouthpiece to the bell. The exact condition depends upon the amount of "warming" of the clarinet. Since this is true, the "short tube" notes are usually produced at a temperature approaching that of the breath, while the "long tube" notes are affected more by the temperature of the room.

Tuning.

Early in the history of this committee a survey was sent to the membership of ASBDA. Included in this survey were questions pertaining to tuning procedures used by those surveyed. There was also a provision for members to request information on tuning problems which were of concern to them.

Several questions kept recurring in the returns of the survey. Among these was one pertaining to the advisability of tuning clarinets to one note. Another was the advisability of always trying to tune the clarinet section to A-440.

These questions were influential in the development of the previously mentioned ASBDA Warm-up and Tuning Standard.

Listing of Pitch Characteristics of Mouthpieces.

Probably the most extensive research conducted to date by the committee was that of listing clarinet mouthpieces in the order of their general pitch characteristics. This research project has been presented to the membership in previous reports. However, the final results have been received only by those members present at the Washington Convention or those who have written for the table as a result of the committees article in the May 1968, Vol. 11 No. 3 of the C. G. Conn Corporation publication, CONNCHORD.

Space will not be used in this report to discuss the methods of research, however, the table and some interesting graphs will be found in the appendix.

FINDINGS

Tuning.

1. The results of the survey showed that a big majority tuned their clarinets to only one tone and that tone is Concert Bb.

2. Very few directors tune their clarinets to Concert F, which is probably the best tone if tuning to only one tone.

3. It is not advisable to tune clarinets to only one tone. The commonly used "long tube" notes Concert Bb or A, are especially undesirable.

4. It is not always feasible to tune to A-440 cps. Tuning to any definite standard is difficult without intelligent selection of mouthpiece and the development of good embouchure.

5. A basic intonation pattern exists which is common to all clarinets. Although individual differences exist, the committee concluded that "there is little difference between good clarinets."

6. The advisability of tuning down at elevated temperatures is seriously questioned. The intonation pattern of the clarinet can be seriously affected by excessive "pull" and the resonance, or "resistance", of the instrument can be changed to the extent of affecting the capabilities of the student.

7. It was found that in general, little difference existed between different methods of tuning the clarinet; i.e., at different joints, except that there is a definite tendency for adjustment at several joints to give imporoved intonation at temperatures above 80 degrees Fahrenheit.

   a. Any pull at the upper end tends to affect the "short tube" notes more than the "long" tube notes.

   b. If the upper end of the clarinet is "pulled" to tune 3rd space "C" at high temperatures, it is likely to be too much "pull" for the throat tones.

   c. Any tuning procedure should include both "long" and "short" "tube" notes.

   d. In no case should the upper pull be more than 1/16 inch nor that between the branches more than 1/32 inch.

Mouthpiece Pitch Characteristics.

Research was conducted pertaining to the tone quality, ease of

blowing, and articulation and staccato control.

Although the data from these tests was sufficient to give the committee an idea of what to expect, it was not felt that enough research had been done to determine a valid set of results.

However, in research conducted at the same time on the pitch level of mouthpieces, the testing was quite extensive and the results were obtained came from a sufficient amount of data to be valid without any question.

Graphs were drawn to help the committee validate its results. Although the graphs themselves were not used as data for the final conclusions they did provide a means of visualizing the differences that were found in the mouthpieces.

On the two pages of this paper which follow, pages 7 and 8, samples of the type of graphing that was done is shown.

Figure 1, shows graphs of nine mouthpieces. These mouthpieces were played by the same tester, on the same clarinet, and under the same conditions. (By the same conditions is meant physical and temperature etc. The tests were performed in an air conditioned room with the temperature controlled.) The numbers indicate cycles per second as measured by Stroboconn. By merely glancing at Fig. 1, it is possible to see that some mouthpieces performed at a lower pitch level than others.

Figure 2, shows two of the mouthpieces as played by five testers. These tests were also performed upon the same clarinet and under similar conditions. As in the previous graph, the instrument had been tuned to A-440 with a control mouthpiece and a tuning ring inserted to maintain the same "pull" on all mouthpieces tested. The graph shows that the pitches obtained by each of the testers were different. However, on the first mouthpiece all tended to be higher than the ones represented by the second graph.

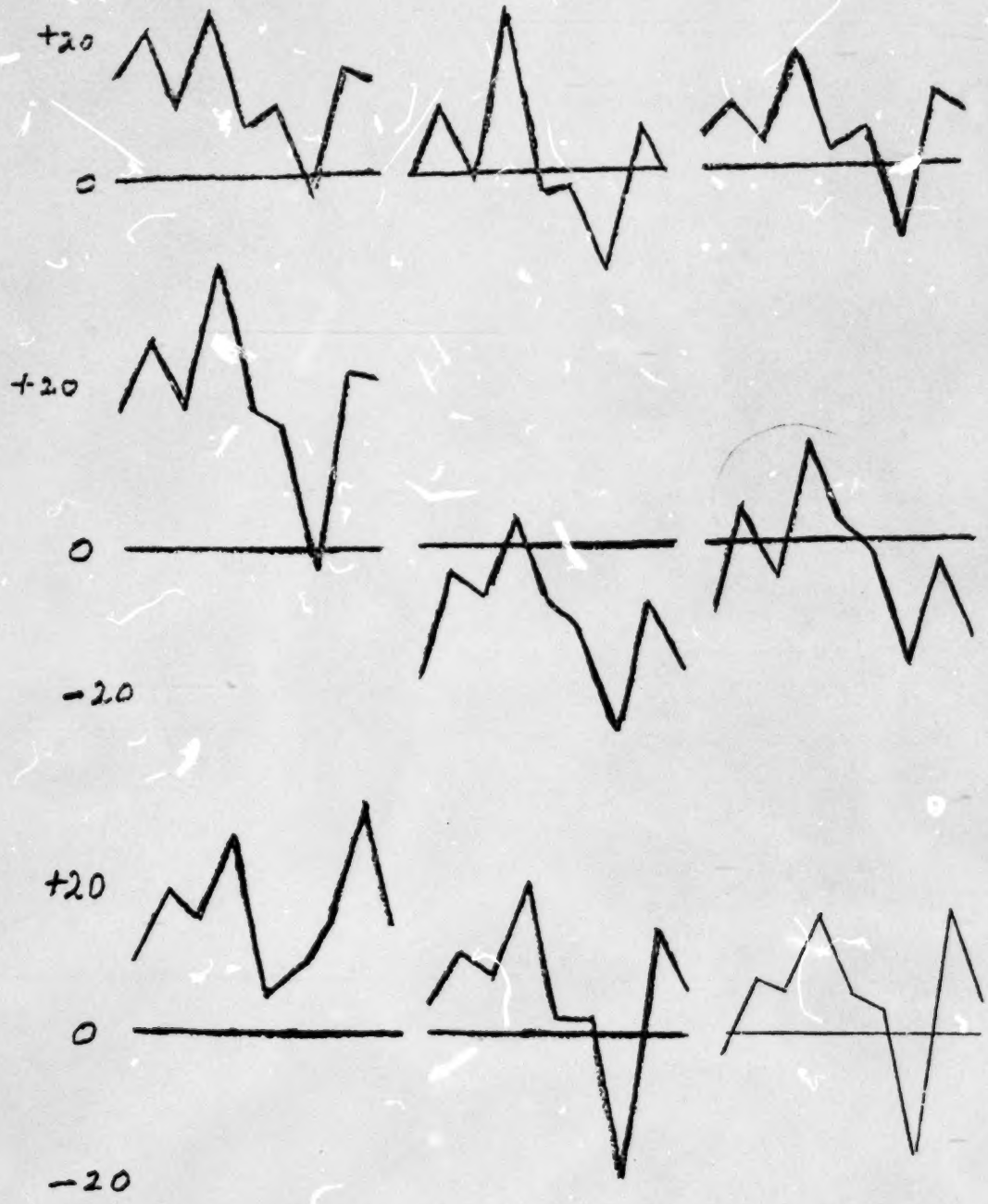

Fig. 1.

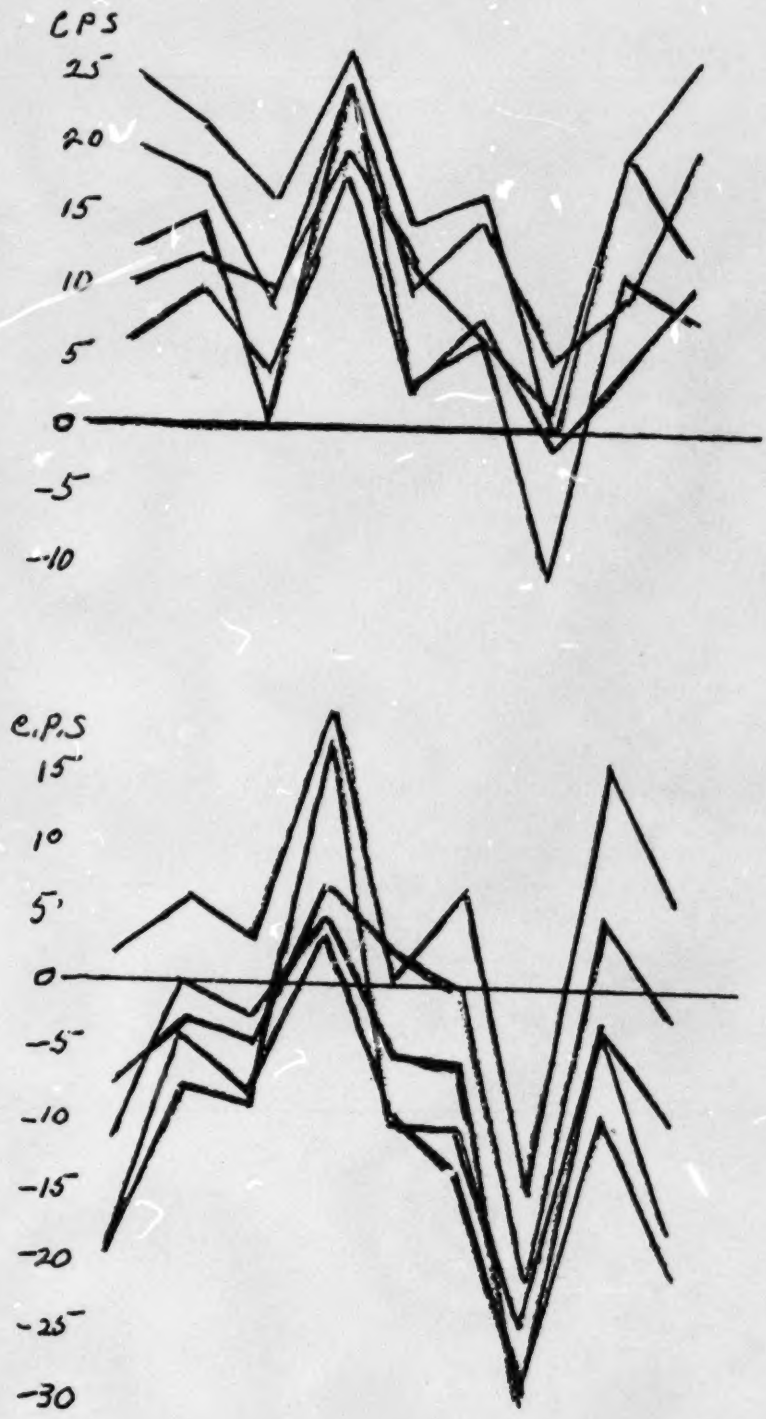

Fig. 2.

CONCLUSIONS

1. In spite of the fine Music Education Departments in our Colleges and Universities many teachers are coming out without a firm foundation of procedures necessary to accurately tune the Bb Soprano Clarinet. Part of this is probably due to the fact that most performers at the Collegiate level know their instrument well enough that they can tune to Concert Bb and make the necessary adjustments. This is not true for performers in general of the elementary and secondary level.

2. Under many conditions a teacher should recommend a mouthpiece which plays lower or higher rather than try to pull to a certain pitch level.

3. Manufacturers should agree to an identification system for all mouthpieces as to pitch level expectancy.

4. There is nothing wrong with a mouthpiece which plays sharp or flat. Both types are necessary for good intonation in a section.

5. The list of mouthpieces included in the Appendix, page 10, should be considered by all directors when trying to solve their intonation problems.

6. As new mouthpieces appear on the market they should be added to this list.

7. A similar test on saxophone mouthpieces would be most helpful.

8. This committee feels that there might be sufficient interest in the information covered in this report to make it available for purchase by interested non ASBDA teachers and directors.

Pitch Level (Cents + or -)	Mouthpiece (Number)	Brand Name and Number
+20.1	1	Selmer S
+15.0	2	Brilhart Personalize 1771 CW
+12.7	3	Selmer HS**
+12.4	4	Vito 2V
+11.7	5	Selmer HS**
+11.6	6	Conn Precision 3
+11.2	7	Selmer S
+ 9.9	8	Selmer Golden Tone 7711
+ 9.6	9	H Couf BL. SP. 2*
+ 9.3	10	Kaspar
+ 8.7	11	Selmer Goldentone 7711
+ 8.1	12	Bradley SP-2
+ 7.8	13	Perfect Playmate 2
+ 7.3	14	Conn Precision 3
+ 7.0	15	H. Couf BL.SP 2*
+ 6.1	16	Conn Connstellation 3
+ 5.9	17	Selmer Goldentone 7711
+ 5.7	18	Brilhart Rubber 201 BR
+ 4.5	19	Brilhart Personaline 1770C B
+ 4.3	20	Conn Connstellation 2S
+ 3.9	21	Brilhart Tonaline 201BT
+ 3.6	22	Brilhart Personaline 1772C R
+ 3.4	23	Brilhart Symphony 2021
+ 3.4		Kaspar
+ 3.1	25	Mitchell Lurie M4
+ 3.1		Benade 7-1/2
+ 2.9	27	Selmer HS*
+ 2.9		Mitchell Lurie M3
+ 2.8	29	Perfect Playmate #1
+ 2.4	30	Arlie Richardson B2
+ 2.2	31	Babbitt MO
+ 1.4	32	H. Couf C. Pl. SP. 2*
+ 1.3	33	Arlie Richardson Artist 2
+ 1.1	34	Arlie Richardson Artist 2
+ 0.8	35	Vandoren 2RV
+ 0.7	36	Buffet C
+ 0.5	37	Woodwind Educator G9
+ 0.5		Conn Connstellation 2
+ 0.1	39	Portnoy Artistes B
- 0.1	40	Brilhart Special E 201BS
- 0.3	41	Mitchell Lurie M4
- 0.4	42	O'Brien #4
- 0.5	43	The Masteller
- 0.9	44	Selmer 201K
- 1.3	45	Couf Artist 3*
- 1.3		Mitchell Lurie M3
- 1.9	47	H.S. Selmer 201K
- 1.9	48	Bradley SP-1
- 1.9		Selmer HS*
- 2.3	50	Conn Connstellation 3
- 2.4	51	Selmer Clarion 401K
- 2.6	52	Selmer 201KS
- 2.9	53	Conn Connstellation 3S
- 3.0	54	Babbitt MO
- 3.0		Brilhart Eboline 201BE
- 3.4	56	Arlie Richardson B-2
- 3.7	57	Woodwind G8
- 4.1	58	Noblet 2V
- 4.3	59	Conn Connstellation 2
- 4.5	60	Selmer Clarion 201K
- 4.9	61	Wells B3
- 4.9		Vandoren 2V
- 5.1	63	Conn Connstellation 3S
- 5.1		Bradley S-2
- 5.1		Sumner Acousticut Prof.
- 5.2	66	The Masteller
- 5.2		Conn Connstellation 2S
- 5.3	68	H. Couf Artist 3*
- 5.7	69	Selmer Clarion 201K
- 6.2	70	Portnoy
- 6.3	71	H. Couf C. Pl. SP. 2*
- 6.6	72	Perfect Playmate
- 6.9	73	Sumner Acousticut Prof.
- 8.1	74	Wells B2
- 8.2	75	Babbitt MO
- 8.8	76	H. Couf Artist 2*
- 9.0	77	Bradley S-1
-11.9	78	H. Couf Artist 2*0

13 The Brilhart mouthpieces included in the table are no longer in production having been replaced with a new series. They have been left on the list for the benefit of those using them who may need to replace them. 14

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STUDENT_____

YEAR IN SCHOOL_____

ABILITY_____

TEMPERATURE_____

DATE_____

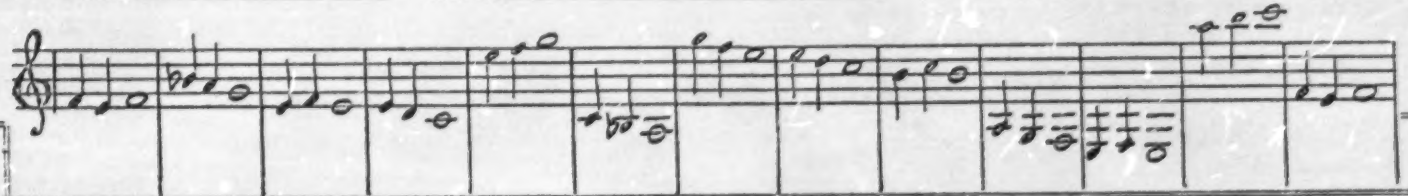
A. S. B. D. A. RESEARCH COMMITTEE

TUNING AND WARM UP STANDARD

REVISED - 1961

CLARINET

BARREL_____ MIDDLE_____ LOWER_____



MPC.	INST.	AMT. PULL		
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